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The effect of origin on the firing behaviour of kaolinitic clays

Aras, A

Yuzuncu Yil University, Geological Engineering Department, Van / Turkey 65080, aras5549@yahoo.com

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Kaolinite minerals in nature have hydrothermal, residual or sedimentary geological origin. As a result they have different crystallinity and usually coexist with different nonclay and impurity minerals. The fine-grained, highly plastic and mainly kaolinitic sedimentary clays can be classified as “ball clay”, but the single term “kaolin” usually denotes primary (residual/hydrothermal) clays. Because of mineral processing of “kaolin” before use in the ceramic industry, the ball clays vary in chemical and mineralogical composition much more than kaolin, and the most prevalent fine sized impurities are quartz from the host rock, illite, and feldspar, which are mixed with disordered kaolin as a result of sedimentary processes. Therefore, three important differences exist between “ball clay” and “kaolin”. First, impurities such as quartz, feldspar and mica are generally present in much coarser grains in “kaolin”, and can be separated by mineral processing (washing and settling), but in ball clays, all these minerals are present even in the finest fraction. Second, the crystallinity of the kaolinite minerals differs, with ordered and disordered kaolinite minerals present in “kaolin” and “ball clay”, respectively. Third, the type of silica phase differs, with mostly fine rock crystal quartz present in ball clay, and fine opaline and chalcedonic microcrystalline quartz in “kaolin”. In this integrated and comparative work two Turkish “kaolins” KU-DM, one Westerwald (Germany) (HB), and one Sile (Turkey) (SE) “ball clay” were selected, and high temperature phase composition and evolution was systematically investigated using XRD and SEM-EDS [1-3]. The sequence of high temperature phase formation and evolution was discussed on the basis of the result of previous and present work, and a review of literature data in this work. High alkaline content, fine rock crystal quartz and poor crystallinity of ball clay caused early cristobalite and late secondary mullite formations, but the good crystallinity and low alkali content, and calcedonic and opaline silica contents of “kaolin” caused early primary mullite and late cristobalite formation in ceramic bodies derived from these clays [4,5]. All these observations of the evolution of high temperature phases in heated KU, DM, SE and HB are consistent with observations of ball clays e.g., Anna-Illinois clay of Wahl et al., Anna-illinois clay of Glass, Florida kaolinite of Tuttle and Cook, and kaolins e.g. English china clay of Dubois, Onike et al., Chakborty et al., Goeorgia kaolinite KGa-1 of Johnson et al., KGa-1 and KG-a2 of Adamo et al. [6-13].

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